REMARKS

In the Office Action the Examiner noted that claims 1, 4-9 and 12-16 are pending in the application and the Examiner rejected all claims. Claims 1 and 9 have been amended. The Examiner's rejections are traversed below.

Rejection of Claims 1, 4-7, 9 and 12-16

In item 2 on pages 2-4 of the Office Action the Examiner rejected claims 1, 4-7, 9 and 12-16 under 35 U.S.C. § 103 as unpatentable over U.S. Patent 4,507,042 to Suzuki in view of U.S. Patent 5,770,936 to Hirai et al. and further in view of EP 0672496 to Nakano.

The Prior Art

The Suzuki patent is directed to a cable support of a robot to ensure smooth operation of the industrial robot. Suzuki discloses tilt arms 12 and 13, a wrist arm 14 and a rotating arm 15. A working tool 2 such as a welding torch, is attached to the rotating arm 15. As recognized by the Examiner, Suzuki does not teach that the arm is controlled by a robot controller, or that the cutting tool includes a variable axis and that the effecting end is a cutting end. However, the Examiner takes the position that these features would have been well known.

The Hirai et al. reference is directed to a non-contacting power transfer apparatus, a non-contacting signal transfer apparatus, and a separate machine apparatus that uses these couplers. Figure 2 discloses controlling the positioning of a tool post 24 at the end of a main shaft 21 as described in column 2 of Hirai et al. Figure 2 is used in Hirai in the context of a discussion of the current state of mechanical engineering (column 2, lines 7-9). The Examiner acknowledges that Hirai does not teach "biasing the cutting end effector toward the final rotation axis, moreover, biasing the end effector toward a direction according to a specific need would have been obvious design choice" (page 3 of the Office Action).

The Nakano published application is directed to a metal container having a trunk pipe and branch pipe, such as a sheath of gas insulated switch gear, and particularly to a welded metal container having a trunk pipe and branch pipe welded thereto and flanges welded to each end portion of the trunk pipe and branch pipe (column 1, lines 3-10). The Examiner relies on Figure 15 of Nakano which is used to illustrate a welding method used to laser weld a flange in a pipe of a branch pipe-carrying tubular pressure container. Figure 15 discloses a laser oscillator

467 and a rotary processor head 466 adapted to apply a laser beam emitted from the oscillator 467 to the surfaces to be welded. The rotary processing head 466 is adapted to be rotated in a direction of arrow 469 (column 14, line 41 to column 15, line 28).

The Present Claimed Invention Patentably Distinguishes Over the Prior Art

Claim 1 is directed to a robot system including a movable arm having a plurality of links and a wrist connected by joints and controlled by a robot controller. The robot system further includes:

> a cutting tool unit mounted on said wrist at a distal end of said movable arm, having a cutting effecting end point biased on a radial offset with respect to a final rotational axis of said wrist and directed to said final rotational axis, and a variable axis varying a position or a direction of said effecting end with respect to final rotational axis of said wrist.

The Examiner does not cite any prior art which clearly teaches the above feature but instead takes the position that this feature constitutes a "design choice". Applicants disagree with the Examiner's position. It is submitted that the Examiner must rely on prior art to show the teachings that are recited in the claims.

On page 3 of the Office Action the Examiner states "it would have been obvious to a person of ordinary skill in the art at the time the invention was made to implement a well known controller and the cutting tool of Hirai in combination with the shape of the end effector taught by Nakano to the robot arm of Suzuki in order to facilitate moving the cutting tool around the object being cut." The Examiner's statement includes an explanation of why the Examiner's created combination would be better. However, the Examiner's statement does not provide any line of reasoning from the prior art which would have led one of ordinary skill to modify the teachings of the relied upon prior art in the manner suggested by the Examiner. It is submitted that one of ordinary skill would not have been led to produce the present claimed invention based on the isolated teachings in the three items of prior art cited by the Examiner. In fact, in the Examiner's statement it is not even clear as to how such modifications would occur. In particular, the Examiner seems to start with taking the teachings of Hirai which only shows a basic machining apparatus in the context of the prior art description in Hirai et al. and then combines the "end effector taught by Nakano to the robot end of Suzuki". It is submitted that the Examiner's rejection does not make out a prima facia case of obviousness, but instead is based on improper hindsight reconstruction.

Further, claim 1 has been amended to recite

> wherein only said final rotational axis of the movable arm is selectively rotated when performing a machining operation on a workpiece.

The Applicants respectfully submit that this feature is not suggested by the prior art. As noted in the last paragraph of the specification, high machining accuracy can be achieved when cutting a pipe-shaped work piece by selectively rotating the final axis of the movable arm without driving other movable arms of the robot. Therefore, it is submitted that the Examiner's rejection should be withdrawn.

Claims 4-7 depend, directly or indirectly, from claim 1 and include all of the features of that claim plus additional features which are not taught or suggested by the prior art. Therefore, it is submitted that claims 4-7 patentably distinguish over the prior art.

Claim 9 is directed to a method of machining a cylindrical work piece with a robot system having plural links, a wrist and a cutting tool unit mounted on the wrist at a distal end of the movable arm wherein "a variable axis varying a position or a direction of said cutting effecting end with respect to said final rotational axis of said wrist" and "arranging a workpiece so that a central axis of the workpiece is aligned with the final rotational axis of said wrist." These features are not taught or suggested by the prior art. Further, it is submitted that the Examiner's analysis which relies on the prior analysis of claim 1 is deficient for the reasons set forth above. In addition, it is noted that the Examiner takes the position that Nakano teaches that the central axis of the work piece is aligned with the final rotation axis. However, Figure 15 of Nakano shows a very simple laser oscillator and cutting tool arrangement and not an arrangement involving a robot system comprising a movable arm including a plurality of links in a wrist connected by joints and controlled by a robot controller. Therefore it is submitted that Nakano does not teach or suggest the features of claim 9. Further, claim 9 has been amended to recite

> selectively rotating only said final rotational axis to perform cutting machining on the workpiece.

Therefore, it is submitted that claim 9 patentably distinguishes over the prior art.

Claims 12-15 depend, directly or indirectly, from claim 9 and include all of the features of that claim plus additional features which are not taught or suggested by the prior art. Therefore, it is submitted that claims 12-15 patentably distinguish over the prior art.

Claim 16 is directed to:

> A method of machining a pipe-like workpiece with a robot system comprising a movable arm including a plurality of links connected by joints and controlled by a robot controller having a software

processing function, and a tool unit mounted on a distal end of said movable arm...

arranging the workpiece so that a central axis of the workpiece is aligned with the final rotational axis of said movable arm; and

rotating said final rotational axis and driving said variable axis in synchronism with the rotation of said final rotational axis to perform a saddle-like cutting or forming a hole on the workpiece.

In connection with claim 16, the Examiner relies on the arguments for claim 9 which in turn rely on the arguments for claim 1. Therefore, it is submitted that the Examiner's rejection is improper and should be withdrawn for the reasons set forth above. It is further submitted that contrary to the Examiner's statement, Figure 3 of Hirai does not teach or suggest "rotating said final rotational axis and driving said variable axis in synchronism with the rotation of said final rotational axis to perform a saddle-like cutting or forming a hole on the work piece."

Therefore, it is submitted that claim 16 patentably distinguishes over the prior art.

Rejection of Claim 8

In item 3 on page 4 of the Office Action the Examiner rejected claim 8 under 35 U.S.C. §103 as unpatentable over U.S. Patent 5,570,920 to Chrisman et al. Claim 8 is directed to a robot system including a movable arm having a plurality of links connected by joints and controlled by a robot controller. The robot system further includes:

a tool unit mounted on a distal end of said movable arm, having an additional rotation axis biased with respect to a final rotational axis of said movable arm and an effecting end biased with respect to said additional rotation axis and directed to said additional rotation axis, and a variable axis varying a position or a direction of the effecting end with respect to the final rotational axis of said moveable arm.

In the rejection the Examiner states:

Crisman does not explicitly teach a robot arm as claimed with controller having a software and the moveability of the arm, however, controlling the robot arm to move using a controller executing the software would have been well known. It would

have been obvious to a person of ordinary skill in the art at the time the invention was made to include a controller to control movement of the robot arm Crisman in order to control full motion of the robot arm.

Crisman et al. is directed to a robot arm end effector in the form of a multi-fingered hand having a conformable grasp. Crisman discloses finger digits 12, 14 and 16 which interact with the base portion 18 attached to a palm 20. The palm 20 and the elements of the end effector 10 are attached to an end of a robot arm 22. The palm 20 is pivotably mounted on the end of the robot arm 22 by wrist means (Figure 1). There is no specific disclosure of the wrist means.

It is submitted that Chrisman et al. does not teach or suggest:

> a tool unit mounted on a distal end of said movable arm, having an additional rotation axis biased with respect to a final rotational axis of said movable arm and an effecting end biased with respect to said additional rotation axis and directed to said additional rotation axis, and a variable axis varying a position or a direction of the effecting end with respect to the final rotational axis of said moveable arm.

Further, it is submitted that the Examiner's rejection is improper because it does not cite prior art to disclose all of the features of the claims. Therefore, it is submitted that the Examiner's rejection is improper and should be withdrawn.

Summary

It is submitted that none of the references either taken alone or in combination teach the present invention. Thus, claims 1, 4-9 and 12-16 are deemed to be in a condition suitable for allowance. Reconsideration of the claims and an early notice of allowance are earnestly solicited.

Respectfully submitted,

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